Technology Opportunity
Glenn Research Center • Cleveland • Ohio
Technology Transfer & Partnership Office
TOP3–00170

Temporal Laser Pulse Manipulation Using Multiple Optical Ring Cavities

Technology

The technology was developed within the Ultra-Efficient Engine Technology Program Office at NASA Glenn Research Center. The subject technology, in conjunction with a high-power Q-switched laser, provides a source of bright pulses useful for ultrahigh-speed imaging. The subject technology fills a niche in the scientific imaging market by creating new capabilities not addressed by existing ultrahigh-speed imaging technology.

Benefits

- The technology is simple, low cost, and relatively compact
- The design parameters are easily optimized to the needs of a particular application
- A model of the design has been tested and proven accurate
- For Raman scattering applications, it provides improved average beam power while limiting peak power to levels that do not damage optical components and cause plasma-spark breakdown in the sample being tested.

Commercial Applications

- Hypervelocity impact studies
- Ultrasonic flame propagation
- Combustion studies using laser-induced fluorescence
- Ballistics and detonics
- Sparks in electronic studies
- Spray and particle analysis
- Digital Particle Imaging Velocimetry (DPIV)
- Laser ablation
- Kinetics of ferroelectric materials

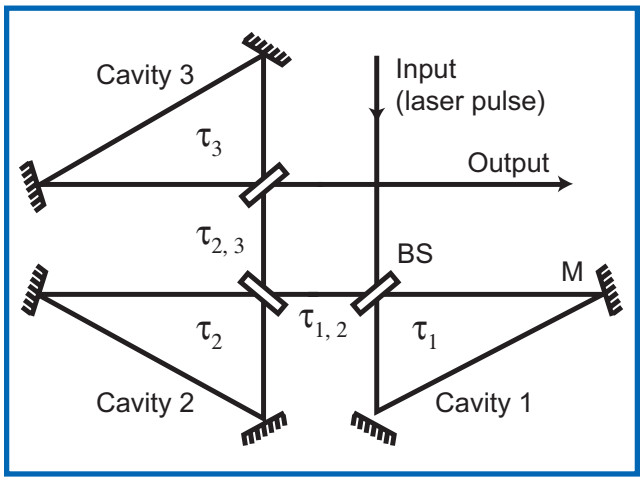

Figure 2.—Schematic of a pulse stretcher with multiple partially transmitting optical ring cavities (three-cavity arrangement). BS, beam splitter, M, mirror, τ_1, a round-trip propagation time (delay time) for each ring cavity; τ_{1j}, propagation time between two cavities $\tau_1 \geq \tau_2 \geq \tau_3$.

Technology Description

The technology is a single laser pulse (of nanosecond timescale) split into multiple smaller pulses which are sent into one or more optical delay lines. The delayed pulses are eventually recombined in space but shifted in time to form a series of pulses that are precisely spaced in time, each with the same pulse width as the input pulse.

This technology is accomplished using fully reflective mirrors and partially reflective beam splitters to form the optical ring cavities that provide the optical delay. By adjusting properties of the optical cavities—such as the number of cavities, the beam splitter reflectivity, and the delay time within the cavity—an efficient multiple-pulse generator suitable for high-speed imaging studies can be realized.

Options for Commercialization

In addition to fostering revolutionary scientific technologies, NASA strives to facilitate transfer of those same technologies to commercial markets. In transferring its technologies, NASA meets its technology needs while earning some return on its investment, and companies can use NASA technology in new markets. Additional developments might be needed to optimize and further refine the properties for specific applications. If your company is interested in licensing this technology or would like additional information, please contact us.

Contact

Technology Transfer & Partnership Office
NASA John H. Glenn Research Center
at Lewis Field
Mail Stop 4–2
Cleveland, OH 44135–3191
Phone: 216–433–3484
Fax: 216–433–5012
E-mail: ttp@grc.nasa.gov
http://technology.grc.nasa.gov

References

LEW–17345

Key Words

High speed imaging

Laser pulse

Beam splitter

Particle imaging velocimetry